

PUENTE DE LA MARINA

(Bridge No. 436)

San Lorenzo-Florida and Cerro Gordo Neighborhoods

Spanning the Rio Grande de Loiza River at Narciso Varona-Suarez Street

San Lorenzo

San Lorenzo County

Puerto Rico

HAER No. PR-38

HAER

PR

71- SANLO,

1-

PHOTOGRAPHS

WRITTEN HISTORICAL AND DESCRIPTIVE DATA

HISTORIC AMERICAN ENGINEERING RECORD  
SOUTHEAST REGIONAL OFFICE

National Park Service

U.S. Department of the Interior

100 Alabama St. NW

Atlanta, GA 30303

HAER  
PR  
71- SANLO,  
1-

## HISTORIC AMERICAN ENGINEERING RECORD

### PUENTE DE LA MARINA (Bridge No. 436)

HAER No. PR-38

**Location:** spanning the Río Grande de Loíza River between the city of San Lorenzo and the Florida and Cerro Gordo neighborhoods, San Lorenzo, San Lorenzo County, Puerto Rico

U.S.G.S. 7.5 minute Juncos, Puerto Rico quadrangle  
Universal Transverse Mercator coordinates:  
1422 IV SW.186995.2013805

**Date of Construction:** 1918

**Engineer:** Rafael Nones

**Builder:** Eng. Luis Benítez-Rexach, for contractor Adolfo López

**Present Owner:** Puerto Rico Department of Transportation and Public Works

**Present Use:** abandoned

**Significance:** Puente de la Marina is a very narrow, 11-span, 90.5m-long concrete slab bridge. The latter is a common bridge technology, used in Puerto Rico mainly between the 1920s and the 1940s, but which is still used in small structures. This technology was judged as not significant enough for inclusion in Puerto Rico's Historic Bridge Inventory, and this bridge was therefore not considered. However, Puente de la Marina is the longest existing concrete slab bridge and one of the first built in Puerto Rico. It was designed by Puerto Rico's most prolific bridge engineer to be a submersible structure across the upstream course of Puerto Rico's largest river. It has modest art deco-style façades, and was San Lorenzo's first highway bridge access to Las Piedras and eastern Puerto Rico. This structure has been judged as eligible for National Register listing by Puerto Rico's State Historic Preservation Office.

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(On behalf of the Puerto Rico Highway and Transportation Authority)

**Date:** July 2000

## A. SUMMARY

The name Puente de La Marina is the Spanish term for "Waterfront Bridge", reflecting the name of the district of the city of San Lorenzo, Puerto Rico where it is located.

Until it was replaced by a new structure about 100 meters upstream around 1997, this narrow structure carried highway PR-980 at kilometer 10.6 over the Río Grande de Loíza.<sup>1</sup> It connects the Florida and Cerro Gordo neighborhoods of the municipality of San Lorenzo with the city of San Lorenzo. The center of the bridge's southeastern abutment marks the boundary between these two neighborhoods.<sup>2</sup>

San Lorenzo is located in east central Puerto Rico, on the western bank of the island's largest river, the Río Grande de Loíza. At that point, about 22 air kilometers upstream from its mouth, the Loíza River is about 25-30 meters wide and shallow enough to be fordable in the dry season (see photo No.6). The location plan (appendix) shows the setting of Puente de La Marina (Bridge No. 436).

Puente de la Marina is located a few blocks away from the San Lorenzo town square, at the end of the Narciso Varona Suárez street (see photo No. 9). Finished in 1918 to serve the Caguas-San Lorenzo-Las Piedras highway, it was San Lorenzo's first highway crossing over the Loíza River. It is owned by the Puerto Rico Department of Transportation and Public Works.

The bridge consists of 11 reinforced concrete slabs, each spanning eight meters (see photo No. 2). Measuring 90.5 meters long by 3.6 meters wide, it stands on concrete abutments and wall-type piers resting on bedrock. Its façades are ornamented with modest art deco style reliefs (see photo No. 11). The bridge is low, its 3.00 m wide roadway being less than 2 meters above the low water level. With 25 cm-high parapets, it was designed to be a submersible structure, meant to present the least resistance possible to high flood waters, which would cover the bridge several times a year. Its parapets are similar to the low concrete obstacles used on modern parking lots to stop car wheels (see photo No. 2).

Bridge No. 436 was designed by Puerto Rico's most important and prolific bridge designer of the first decades of the 20th Century, Eng. Rafael Nones, under a project name that translates as: "Submersible Bridge for the Loíza River". It was built in about six months at a cost of \$13,284.89 by Eng. Luis Benítez-Rexach for contractor Adolfo López.

The bridge has suffered no significant damage or permanent alterations, although it had steel walkways attached both sides of the narrow roadway between 1982 and about 1996. These pedestrian facilities, installed by the municipality, had removable pedestrian safety rails, built of steel pipe. The rails were supposed to be taken off by city employees when flooding was imminent to prevent them from stopping flood debris and becoming a significant flood hazard for upstream structures.

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<sup>1</sup> That kilometer numbering corresponded to route PR-980 before it was altered to connect to the new bridge. Today, that highway follows a different route accessing San Lorenzo and within its city limits.

<sup>2</sup> Puerto Rico, a Spanish Colony until 1898, does not have counties. It is divided instead into municipalities, which are made up of barrios. Cerro Gordo and Florida are barrios of San Lorenzo, as is the urban area, called Barrio Pueblo (town). Barrios are represented in city councils.

This bridge is not listed in the "Puerto Rico Historic Bridge Inventory Project", which dealt with highway and railroad bridges built on or before 1945. Bridge No. 436 was not considered individually for inclusion in the inventory because its concrete slab technology was categorized as "minor engineering", not embodying enough technological merit for listing as a "historic bridge".<sup>3</sup>

There are, however, several elements which do provide historic significance to Puente de La Marina: it has historic integrity; it has recognizable art deco reliefs and hatched surfaces on the façades of the slab and the piers; it spans Puerto Rico's largest river. Within its type of technology in Puerto Rico, it is one of the oldest, as well as the longest existing one, and possibly the longest one built. Together with the route served, it connected two cities for the first time and opened a region to highway traffic and improved economic development.

To reduce flood damage to upstream structures, the Puerto Rico Highway and Transportation Authority will remove the bridge. In this mitigation project, the bridge has been documented photographically and historically to HABS/HAER's Level 2, as defined in the corresponding Memorandum of Agreement.

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<sup>3</sup> Pumarada-O'Neill, *Los puentes...*, Appendix.

## B. DESCRIPTION AND CONDITION OF THE BRIDGE

The bridge is a very low and narrow reinforced concrete structure consisting of 11 reinforced concrete slabs resting on wall-type piers plus end access segments.

It is 90.5 meters (291'10") long. Its roadway, defined between parallel rows of very low parapets, is only 3.00 m (9'10") wide. The parapets, 3.3 m long and set 80 cm apart, are only 25 cm (10 inches) high. The total width of the structure, measured to the faces of the slab, is 4 m wide. Its superstructure consists of eleven 55 cm (24 inches) thick (60 cm at the centers) reinforced concrete slabs plus access segments on fill. The slab's clearance over the dry season water level is about 1.5 m. The slab spans measure 8.00 m (26'10") each, with their construction joints above the center of each pier. The wall-type piers are 80 cm (32 inches) thick, with their faces 4.00 m (13'5") apart (see photo No. 2).

The concrete slabs are 60 cm thick along their longitudinal centers and 55 cm at the edges, reinforced with twisted steel bars of 2.5 cm (1 inch) diameter, set 15 cm center to center; and temperature reinforcing bars of .95 cm (3/8 inch) diameter, set 30 cm apart, center to center. Each span is made up by a single slab, with construction joints over the centers of the piers.

Its façades, consisting of the thickness of the slab edges and of the piers, are ornamented with art deco-style reliefs. These consist of rectangular borders of the full size of each slab's span, and shorter ones over each pier; plus rectangular borders on the face of each pier. (see photo No. 11) Traces of roughness, the result of a hatchet finish, are sometimes evident in the incuse rectangles in spite of the severe discoloration, weathering and erosion.

The bridge, whose piers and abutments all rest on bedrock, is structurally in good condition. However, the parapets, slab, and piers show evident signs of wear and have lost most corners and edges. Some parapets are missing and many are broken. The hatchet surface finish is hardly visible on the pier edges.

There are some bent, rusty pieces of steel still bolted to the sides of the slabs and piers (see photo No. 11). Some of the pieces on the northeast face, opposite the direction of the water flow and thus more protected from debris impact, were installed in the early years of the structure to carry two water pipes of approximately 16" diameter each, one above the other. The other pieces supported the cantilevered steel plate walkways installed on December 1982 on both sides of the narrow bridge for safer pedestrian traffic.

## C. HISTORICAL BACKGROUND

### Development of the Caguas, San Lorenzo and Las Piedras region

The largest river in Puerto Rico is the Río Grande de Loíza (Loíza River), which flows northward to the Atlantic Ocean from an area between the Cordillera Central and the Sierra de Luquillo mountain ranges, southeast of San Juan. The Turabo Valley, eroded by the middle Loíza River out of a volcanic rock formation, is the largest in Puerto Rico. It is bounded in the north by a hilly formation which extends up almost to the island's Atlantic coast; on the west and south by the Cordillera Central mountain range; and on the east by the Sierra de Luquillo mountains. East of the Turabo Valley lies the valley of the Río Valenciano, a tributary of the Loíza River, and beyond is the upper valley of the Humacao River, which flows into the Caribbean at the southeastern coast of Puerto Rico. These three valleys, and the hills which separate them in central eastern Puerto Rico, get a humid 85 inches of rain per year. The soil of the area, underlaid by volcanic and igneous rocks, is gravelly. In pre-Columbian days, the region was covered by low-mountain tropical forest, except for some savanna, mostly in the flood plains, and, to the northeast, by rain forest.<sup>4</sup>

The central part of the Turabo Valley was named Caguas after Caguax, a 16th Century Taíno Indian chieftain who collaborated with conquistador Juan Ponce de León, and whose daughter, baptized as María, was stripped of her lands and sent away to forced labor with her villagers at a royal farm.<sup>5</sup>

In the early days of the Spanish Conquest of Puerto Rico, European settlements were limited to the western two thirds of the island, the part closest to the earlier colony of Hispaniola and to the riches of Mexico and Peru. Migration to the eastern third began to grow slowly by mid 17th Century, drawn by the fertile, well-watered virgin valleys and its ports, closest to the contraband-avid Sugar Islands.

An important settlement of that era took place within the extensive cattle raising property ("hato" was the Spanish term of the times) that Spain had conceded to Sebastián Delgado-Rivera. Sebastián, married to María Manso de la Torre, was the son of Captain Mateo Delgado-Fonseca, a war hero who played an important role in the ouster of the Dutch invaders from San Juan in 1625.<sup>6</sup> This property, the island's largest ható, was called Hato Grande. It included the Turabo Valley and the valley of the Valenciano River, lands which today constitute the municipalities of Gurabo and Juncos plus parts of Las Piedras, San Lorenzo, Caguas and Aguas Buenas.<sup>7</sup> The ható was crossed by the Río Grande de Loíza, called Cayrabón by the Taínos. During the 17th and part of the 18th Century, this river had divided the territories of the towns and parishes of Río Piedras and Loíza, between both of which the Hato Grande was divided. Loíza also included the upper

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<sup>4</sup> Bernat, *Atlas...*, xii-xxii.

<sup>5</sup> Acosta, *Santa...*, 17-18

<sup>6</sup> Morales, *Los orígenes...*, 36.

<sup>7</sup> Bunker, *Historia...*, 72.

Humacao River valley, site of another important hato, the Hato de las Piedras. It took its name from the large, rounded magnetite rocks which dot the hills north of the valley.

In 1775, Puerto Rico's properties were divided among 269 hatos and 4,579 farms.<sup>8</sup> In spite of the fact that as a rule most of an hato's lands were covered by forests, the production of the hatos, mainly leather for legal or contraband export, represented the island's most important export good after the depletion of its placer gold deposits.<sup>9</sup>

The Delgados erected their home near the Loíza River. This site, called Barrero because it produced good firing clay, soon came to have an ermita chapel and a few houses.

In 17th Century Puerto Rico, as well as in other Latin American countries, the term "ermita" denotes a primitive chapel accessible to a disperse rural population. It is expected to serve at least 30 faithful families who live more than six leagues away from the parish's main church. The parish periodically sent a priest, ideally three times a year for one month at a time, to celebrate Mass and administer sacraments. The hato and farm owners all contributed to the construction, upkeep and expenses of the ermita, and each year covered three month's salary for a priest. Where a single property owner provided most of the support, the ermita was usually was dedicated and named after his or his wife's patron saint.

From Barrero, settlers moved east and southeast along the river valleys. Another settlement grew in the mid-1600s farther up the Loíza river, in the southeastern part of the hato of the Delgado family. Eventually known as San Miguel de Hato Grande, it became the only village to keep the hato's original name. The village of San Miguel was named after Archangel Saint Michael, the patron saint of its ermita, which in turn had been named after the patron of its major sponsor, Miguel Muñoz de Oneca y Saavedra.

In the first half of the 18th Century, the lands which contained this new settlement were the property of Miguel Muñoz. His wife, María Delgado-Manso, was the eldest of the several Delgado heirs who divided up the original Hato Grande.<sup>10</sup> The Ermita de San Miguel de Hato Grande was used by the Parish of Río Piedras to hold Mass for the scattered neighboring settlers. A marriage held in 1737 in the Ermita de San Miguel de Hato Grande is documented in the parochial archives, showing that the chapel existed at that early date.<sup>11</sup>

After 2.5 centuries of being the economically stagnant site of a Spanish military outpost, Puerto Rico was finally beginning to see some economic development in the second half of the XVIII Century. Cattle raising gave way to coffee and tobacco farming, and more and more families migrated inland to live off the land. Lowland forests were cleared and trails were widened to allow the passage of ox-carts. Improved health and nutrition nurtured a drastic population growth. As a result, more towns were founded in that period than in the preceding centuries of Spanish dominance.

Piñal, another settlement within the original Hato Grande lands, was located southeast of the confluence of the rivers Gurabo and Loíza, in lands that are today part of the municipality of

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<sup>8</sup> Morales, *Op cit.*, 35.

<sup>9</sup> Morales, *Op ci.*, 17.

<sup>10</sup> Morales, *Op cit.*, 30.

<sup>11</sup> Morales, *Op cit.*, 57- 60, 73.

Gurabo. Its population had surpassed Barrero's and soon became a parish, called Sweet Name of Jesus, and a village, called Caguas, in 1775.<sup>12</sup>

Meanwhile, by 1773, the former Hato de las Piedras belonged to the municipality of Lofza. At the place called Ribera de las Piedras (Riverbank of the Rocks), hub of the former hato, there were only three houses and an ermita chapel. The rest of the 1,515 neighbors were scattered in the valley and neighboring hills. When Caguas became a separate municipality, the former hato became a part of Caguas. But when Humacao was granted its township in 1793, Las Piedras became a part of that coastal jurisdiction. In 1801, Las Piedras finally became a separate municipality, with lands totaling 156 km<sup>2</sup> (60 square miles). The construction of a parish church dedicated to Our Lady of the Immaculate Conception was begun at that date.

Local tradition and some historical sources date the official creation of the village of San Miguel de Hato Grande in 1811. In 1812, Puerto Rican Bishop Arizmendi visited the village's ermita to find out that its patron had been changed, without due process, from Archangel Saint Michael to San Lorenzo, a martyr who had been grilled to death. The local priest defended himself by declaring that this change had been forced by a regional strongman, Caguas' lieutenant-mayor Juan Rodriguez-Calderón, who claimed having had several visions of the martyr saint near the Lofza riverbanks. This controversy did not stop Arizmendi from upgrading the ermita, which at the time belonged to the parish of Caguas, into a separate parish, with the name of San Lorenzo, in November, 1812. The parishioners, prompted by the saint's legendary apparitions, backed and officially obtained the new name. So, when the village became a town, between March 1813 and April 1814, it was called San Lorenzo.<sup>13</sup>

By 1831, the farms of San Lorenzo were producing coffee, beans, rice, and minor crops. Timber was being extracted from its still abundant forests, and small amounts of gypsum were being mined. Its population, almost all rural, was 3,446 in 1824. In 1830 there were only 112 slaves.<sup>14</sup>

The population of San Lorenzo in 1897 was 12,763 in its 138 km<sup>2</sup> (53 square miles). Its main crop was still coffee, followed by subsistence crops, sugar cane and tobacco.<sup>15</sup>

In the first three decades of the 20th Century, coffee exports and prices declined markedly, mostly as a result of the response of the European markets to the US takeover of Puerto Rico. San Lorenzo's economy came to rely then mostly on the production of tobacco, as did most eastern-central Puerto Rico during that period of heavy tobacco exports to the US. Canefields also expanded in the valleys, pushed by the analogous prosperity of sugar in the first half of the century. The town flourished at the time because tobacco was the industry that paid the highest wages in the island. In 1935, with tobacco prices and wages dropping, the agricultural census had San Lorenzo ranked as the 2nd tobacco-producing municipality in Puerto Rico. Its 24,200 acres and 1424 farms were the highest figures in Puerto Rico. From the 1940s onward, the tobacco

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<sup>12</sup> Bunker, *Op cit.*, 75, 132. The town was later moved to the present site of the Caguas city center. Later on the old site of Pifial became part of Gurabo when that municipality broke off from Caguas.

<sup>13</sup> Morales, *Op cit.*, 77-80, 94, 104.

<sup>14</sup> Morales, *Op cit.*, 316-17.

<sup>15</sup> Morales, *Op cit.*, 331.

industry could only precariously sustain a dwindling number of small family farms. By the 1970s, tobacco farming had almost disappeared from Puerto Rico.

When the Popular Democratic Party won the 1948 and 1952 Puerto Rican elections in unanimous landslides, it began to undermine the power of the local and absentee sugar barons. Its Operation Bootstrap Program brought manufacturing jobs to the poor, who no longer accepted the exploitation of the sugar plantations, Puerto Rico's main employers. San Lorenzo, however, had never been dominated by sugar cane, and by 1956 it had only had a single, 50-job manufacturing plant. With tobacco salaries being the lowest in Puerto Rico at the time, a desperate San Lorenzo gave the Popular Democratic Party its only municipality-level defeats in the 1956 and 1960 elections.<sup>16</sup>

San Lorenzo's population in 1980 was 32,428, with 75% living outside of the urban area. This corresponds to a 15% approximate gain in the period between 1940 and 1980. Its economy in the mid 20th Century depended on commerce and some light manufacturing; its main crops were sugar cane, cattle pastures for milk and meat, fruits and other minor crops.<sup>17</sup> With the closing of the remaining four C. Brewer firm's sugar mills by the 1970s, sugar cane disappeared from northeastern and central eastern Puerto Rico.

In 19th Century Las Piedras, the economy was centered in sugar cane, cattle, timber and subsistence crops. Only 195 acres were planted in coffee at the peak of Puerto Rican coffee production in 1897. As part of the centralization efforts that took place immediately after the US invasion in 1898, Las Piedras lost its status as an independent town, recovering it in 1914. During the first half of the 20th Century, tobacco became a very important crop. Its agriculture simmered in the second half of that century, with sugar cane and tobacco giving way mainly to milk production and fruits. Favored by the better highway access of Las Piedras, several different light manufacturing firms took the slack in employment, sustaining a population growth of about 35% between 1940 and 1980. The population of Las Piedras in 1980 was 22,412, about 75% of which was rural.<sup>18</sup>

#### **Highway communication between Caguas, San Lorenzo and Las Piedras**

Land transportation between Caguas and San Juan in the 17th and 18th Centuries was served by wagon roads, but between Caguas and the neighboring settlements and villages it depended mostly on trails and hoof paths. In 1812, the citizens of Caguas had repaired the wagon road along the narrow lower Loíza River valley which connected their town with Río Piedras and San Juan.<sup>19</sup>

Until 1842, the building of roads and highways in the Spanish colony of Puerto Rico had been left up to the initiative of municipalities and plantation owners. On that year, the Spanish government created the Commission of Roads and Channels, and a fund for the construction of roads and highways with a lottery game to feed it. At the beginning of the second half of the 19th Century, partially encouraged by military considerations, a complete plan of first and second order highways was designed for the island. Its population, numbering about half a million people, was

<sup>16</sup> Martínez-Fernández, *Mapa...*, 7, 18-19.

<sup>17</sup> Bernat, *Op cit.*, xxxiv.

<sup>18</sup> Bernat, *Op cit.*, xxxi; Junta de Planificación, *Op Cit.*, 4-5.

<sup>19</sup> Bunker, *Op Cit.*, 269.

concentrated along the coastal plains, while most of the western mountains were uninhabited. The planned highway system was based on a first order highway encircling the island, and second order roads connecting it to the towns of the interior. However, military and practical considerations, such as the fact that the coastline was being served by scheduled shipping lines connecting all the important ports, caused the plan to be modified by including a first order north-south highway linking San Juan and Ponce across the central mountain range through Caguas and Coamo. This highway was the first of the plan to be built, between the 1850s and 1886.

By 1813 there existed a wagon road between Caguas and San Lorenzo. In 1831, the citizens of San Lorenzo were requesting improvements in the six existing wagon trails and roads, including those going to Caguas and Las Piedras, in addition to the construction of a new wagon road to the south. By 1858, once the San Juan-Caguas highway had been finished, work had begun on the first segment of a highway which would connect Caguas and Humacao through San Lorenzo and Las Piedras. An appropriation for completing the first segment out of Caguas was approved in 1862. A second segment, however, was not approved for construction until 1896.<sup>20</sup>

On April 27, 1897, an announcement in the official publication of the Spanish Colonial government invited bidders for the construction of the San Lorenzo-Las Piedras highway. On June 9, 1897, Madrid contractor Jose Nieto de Molina signed the project's contract for 172,644.76 pesos.<sup>21</sup>

By the time of the US invasion in 1898, there were reportedly 2.5 kms under construction of the Caguas-San Lorenzo highway, corresponding to the initial stretch of the first order highway which would connect Caguas (and thus Ponce and San Juan) with the southeastern coastal town of Humacao.<sup>22</sup> The 12 km segment between San Lorenzo and Las Piedras was also under construction.<sup>23</sup>

On December 13, 1898, weeks after the Spanish American War had shortchanged Puerto Rico from an autonomous province of Spain into a military colony of the United States, the San Lorenzo city government was requesting the military government in San Juan to resume work on the highway, which had been stopped as a result of the war. Headquarters answered that the Madrid contractor had rescinded his contract due to the new political situation.<sup>24</sup>

However, the unfinished stretch between Caguas and San Lorenzo had been virtually completed by 1901.<sup>25</sup> But soon, a new civilian colonial government changed the priority of the Caguas-San Lorenzo-Las Piedras highway to second order.

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<sup>20</sup> Marín, *Op Cit.*, 196.

<sup>21</sup> Marín, *Op Cit.*, 198.

<sup>22</sup> The article, based on official documents prepared in 1898, does not mention any completed segment of highway between Caguas and San Lorenzo. Perhaps the segment reported as finished in 1862 was being paved in 1898 and thus reported as under construction.

<sup>23</sup> R.O.P., April 1924, 163-164.

<sup>24</sup> A.G.P.R.: Public Works Series. Box 2367, Document 272.

<sup>25</sup> Marín, *Op Cit.*, 196.

San Lorenzo's first reliable access dates from around 1907. It was the private, cane sugar railroad of Central Santa Juana, a sugar mill which was beginning to operate in Caguas. A one-meter gage railway had been laid alongside the Loíza river from the Belgian-owned sugar mill, just north of Caguas, almost up to the town of San Lorenzo. This railroad had connections to the Porto Rico Railway Light and Power rails between Caguas and Río Piedras, and hence to the island's main line, the American Railroad, connecting Río Piedras to the San Juan-Ponce line along the west coast.<sup>26</sup>

The sugar mills usually permitted cargo to be delivered using their railways, and in some cases they also permitted passenger traffic as well. But their main purpose was to bring rail cars to be loaded with sugar cane at loading stations served by rail spurs. The cane was brought to these places by ox carts.

The Caguas-Humacao highway was indeed completed, but through Gurabo and Juncos, to the north of San Lorenzo. That route, more favorable to sugar cane exploitation, had been assigned priority above the San Lorenzo route. The downgraded latter city found itself served at that date, other than by private rail, only by unfinished roads plus wagon and hoof trails, while all of the towns around it were connected by paved highways.<sup>27</sup>

Work was not resumed on the San Lorenzo roads until after 1906, when the first public works bonds had been issued in Puerto Rico. This measure boosted the construction of roads and bridges, which until then had been paid out of yearly budgets.

In October, 1907 a contract was convened with José E. Denton for constructing 2.4 kilometers with a due date of March 21, 1908. Another contract was awarded a few days after the latter date to contractor F. Rexach, from the neighboring town of Juncos, for macadamizing 2.3 unfinished kilometers. The work was to be finished by September 12, 1908.<sup>28</sup>

Puerto Rico's 1908 highway map shows missing segments of highway in the middle of the Caguas-San Lorenzo route, and on the San Lorenzo end of the San Lorenzo-Las Piedras course.<sup>29</sup>

After that, no further work was done until a contract was awarded on September 27, 1915 to Antonio Castillo, from Camuy, Puerto Rico, to finish the stretch of highway. However, the Puerto Rico Department of the Interior itself had to build the final 5.855 kilometers after the contractor bowed out.

A paved (macadam) highway finally connected Caguas, San Lorenzo and Las Piedras on November 6, 1916, but until the construction of the Puente de La Marina it crossed the Loíza River by means of a ford, complemented by a small ferry boat.<sup>30</sup> The highway was paved with asphalt

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<sup>26</sup> Acosta, *Op cit.*, 49.

<sup>27</sup> R.O.P., 1928, p.1546. Mr. Delfín Aponte, personal communication. The boatman was nicknamed Don Beno. The crossing was in deeper waters, a few meters upriver from the bridge, at a place known as Charco La Yola.

<sup>28</sup> Marín, *Op Cit.*, 198-200.

<sup>29</sup> R.O.P., *Idem*.

<sup>30</sup> Marín, *Op Cit.*, 198-200.

between 1926 and 1927, as part of a program to cover all the existing obsolete macadam surfaces.  
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Since the 1980s, with the construction of a shorter, high speed link between San Lorenzo and the main Caguas-Humacao Expressway, which passes right next to Las Piedras, the direct San Lorenzo-Las Piedras highway lost not only its regional importance but also its role as the main link between the two cities. Since that time it has been just another road connecting each city with a part of its hinterland.

#### **The Puente de la Marina (Bridge No. 436)**

On September 10, 1917, Puerto Rican legislator Tous-Soto introduced a bill assigning \$15,000 for the construction of a bridge over the Loíza River for the newly finished San Lorenzo-Las Piedras highway. In the hearings that followed, this total was considered too low. Eng. Rafael Nones, chief bridge designer for the Department of the Interior and Puerto Rico's most successful and prolific bridge designer of the first decades of the 20<sup>th</sup> Century, stated that a regular bridge would cost about \$40,000 at that spot, while a submersible bridge, that would not be passable only for several hours at a time, three or four times per year, could cost about half that sum.

Once designed by Nones himself,<sup>32</sup> the submersible bridge's construction was contracted early in 1918 for only \$12,550. Its pier foundations were made in concrete after excavating a few feet to the bedrock within wooden caissons drained by water pumps. The parapets were reinforced with steel following a change order. Another change order requested a decorative hatchet finish on its pile and slab edges. The authorized change orders raised the total to \$13,285. The one-inch asphalt pavement designed for covering the concrete slab was not provided because there was no asphalt available in the local market. The amount quoted for this item was retained by the PR Department of the Interior. The final payment after adjustments, certifications, credit for asphalt, and change orders was \$11,305.70. The structure was erected in about six months.

The extreme narrowness of this bridge is probably due to the fact, that being a submersible structure, it was important for it to have a minimum drag. The standard concrete bridges of those years were often twice as wide as Puente de la Marina.

The bridge, whose erection was supervised by Eng. Luis Benítez-Rexach for contractor Adolfo López, was conditionally accepted by the Department on October 17, 1918.

A December inspection report certifies that by that time the structure had survived undamaged two floods which rose at least a full foot above the level of the roadway. Final acceptance after the trial or conservation period in which it was submerged by at least four floods with no resulting damage, took place on February 5, 1919.

The bridge crosses the Loíza River as well as a small tributary, the Quebrada Puerco (Pig Brook), which discharges into the river a few meters downstream from the bridge. In the dry season, the Loíza runs under most of the western third or half of the structure. The brook runs under the southern 2nd and 3rd spans (see photo No. 8).

The highway bridge was located at the end of the Calle San Pío street, now called Calle Narciso Varona Suárez, which comes down from the vicinity of the town square, a few blocks

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<sup>31</sup> Marín, *Op Cit.*, 258.

<sup>32</sup> A.G.P.R.: Public Works Series. Box 2371, Document 278.

away. The southeastern sector of the town, next to the river, is traditionally known as "La Marina" (the waterfront), and the bridge reaching it soon became known as Puente de La Marina. Although San Lorenzo is not a coastal city and the Loíza River is not navigable this far from its mouth, oral tradition states that there used to be a ferry crossing a few meters upstream from the bridge's site.

When a Bridge Evaluation Office was created in Puerto Rico and existing bridges were assigned numbers in the late 1940s, this one received number 436.

By the time the submersible bridge was built, the Central Santa Juana railway which came from Caguas above the east bank of the Loíza River crossed the San Lorenzo-Las Piedras highway just beyond the southeastern end of the bridge (see photo No. 3). After this grade crossing, the highway turned south for about 50 meters before heading east to Las Piedras. The railway went on to cross the Quebrada Puerco brook about ten meters upstream from the grade crossing by means of a small bridge, now dissapeared, and ended almost one kilometer farther south, at a cane loading station located between the Loíza River and Quebrada Puerco.

In the 1970s, a cemetery was built in Barrio Florida. Its access road began just off the bridge, next to the railroad crossing, went parallel to the now abandoned railway, and used a rebuilt railroad bridge to cross a small tributary about 100 meters northeast of Puente de la Marina.<sup>33</sup>

In December 17, 1982, cantilevered steel plate pedestrian walkways were added on both sides of the bridge. This project was sponsored by the municipality of San Lorenzo under Mayor José Antonio Delgado-Rodríguez. It was built by the local firm Rosfeli Construction at a cost of \$168,795.68.<sup>34</sup> These pedestrian sidewalks, installed by the municipality, had removable pedestrian safety rails, built of steel pipe, which were to be taken off by city employees when flooding was imminent to prevent them from stopping flood debris and becoming a significant dam-hazard for upstream structures.

The safety rails did not last long. In a few years most of them had disappeared. But the sidewalks lasted until they were dismantled along with the water pipes after the bridge was abandoned.

There are stories and legends told about the bridge, mainly related to the fact that it was a submersible bridge. There was a well known character in town who used to swim across the flooding river in the vicinity of the bridge. There is also more than one story of persons and cars crossing the bridge as the rising waters began to cover it, with cars getting stalled and valiant persons, belted by heavy rains and with the rising water reaching their knees, pushing the cars and carrying passengers. One such person, Mr. Delfin Aponte, eventually married a young lady that he helped out of a stalled car and carried across the flooding bridge.

### **Significance:**

Portland cement had been in use in Puerto Rico in the late 19th Century, but its high price limited its use in bridges to foundations. Cement was then imported in barrels from Northern Europe. US sovereignty after 1898 allowed tax-free imports of American cement just when reinforced concrete technology was coming of age. The first decade of the 20th Century saw several significant concrete bridges built in Puerto Rico.

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<sup>33</sup> Marín, *Op Cit.*, 210.

<sup>34</sup> Marín, *Op Cit.*, 198-200.

The first documented use of concrete in bridge superstructures in Puerto Rico is the arch. It was the first U.S. bridge technology to be transferred to Puerto Rico. During the 1910s, concrete became the standard material for bridge substructures and decks. By 1918 it was being used in short-span beam and slab bridges, while arches were displacing steel trusses in mid-size spans.

In concrete beam bridges, the main girders run longitudinally under a concrete deck and support it directly. In concrete slab bridges, a thicker, uniform deck is reinforced longitudinally, becoming a wide beam that supports itself and its loads. It is used for shorter spans, generally over a series of piers. Concrete slabs are cast individually or continuously over their supports, with spans usually between 6 and 8 meters. Many concrete beam and slab bridges up to the 1930s had architectural detailing, usually in the parapets and the tops of the piers.

Concrete slabs were typically used for multispan structures in locations where pier construction was not expensive, especially when clearance problems existed. Concrete slab bridges from that era are still common in most parts of Puerto Rico. The majority dates mostly from the 1930s and 1940s. Many of them have widths that are acceptable for secondary roads, and thus are not slated for replacement. As concrete is fairly durable in mild climates, even the few abandoned slab bridges are rather well-preserved. Many of them, especially the older structures, have some architectural details, usually balustrades and pier moldings.

The Puente de la Marina is not listed in the "Puerto Rico Historic Bridge Inventory Project", which dealt with highway and railroad bridges built on or before 1945. This inventory, conducted between 1989 and 1992, was sponsored by the Puerto Rico Highway and Transportation Authority and the Federal Highway Administration. The Institute of Puerto Rican Culture and the State Historic Preservation Office of Puerto Rico participated in the selection of criteria, and in bridge evaluation and selection. Puente de La Marina was not considered on an equal footing for inclusion in the inventory because its concrete slab technology was categorized as "minor engineering", not embodying enough technological merit for listing as a "historic bridge". This criteria judgment was made by the blue-ribbon panel which set the inventory criteria, and was approved by four agencies: the State Historic Preservation Office, the Institute of Puerto Rican Culture, the PR Highway Authority/Department of Transportation and Public Works, and the Federal Highway Administration.<sup>35</sup> The panel and the agencies did consider and include a few "minor engineering bridges" because of their exceptional landmark or architectural value, or as representative examples of their respective "minor engineering" technologies.

Puente de la Marina has historic integrity and is the longest existing concrete slab bridge in Puerto Rico, if not the longest one built, and is also one of the oldest. It was built as a submersible structure to span the upstream course of Puerto Rico's largest river; it has modest art deco-style façades, and was San Lorenzo's first highway bridge access to Las Piedras and eastern Puerto Rico. It has been providing service for most of its 82 years at a site which is only a few blocks away from the town square, reappearing from beneath the reddish-brown flooding waters every time, while other not-so-well-built structures got washed away or were damaged.

The Puente de la Marina was considered to represent its type, multi-span concrete slab bridges, but it was discarded because of its atypical narrowness, the deterioration of its ornamentation, and the fact that at the time that it was surveyed it was altered by the presence of the steel sidewalks. The importance of the designer, Eng. Rafael Nones, would have added to the bridge's historicity index, but this fact was not known at that time. It has since been judged as eligible for National Register listing by Puerto Rico's State Historic Preservation Office.

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<sup>35</sup> Pumarada-O'Neill, *Idem*.

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*A.G.P.R.*: Puerto Rico General Archives, San Juan.

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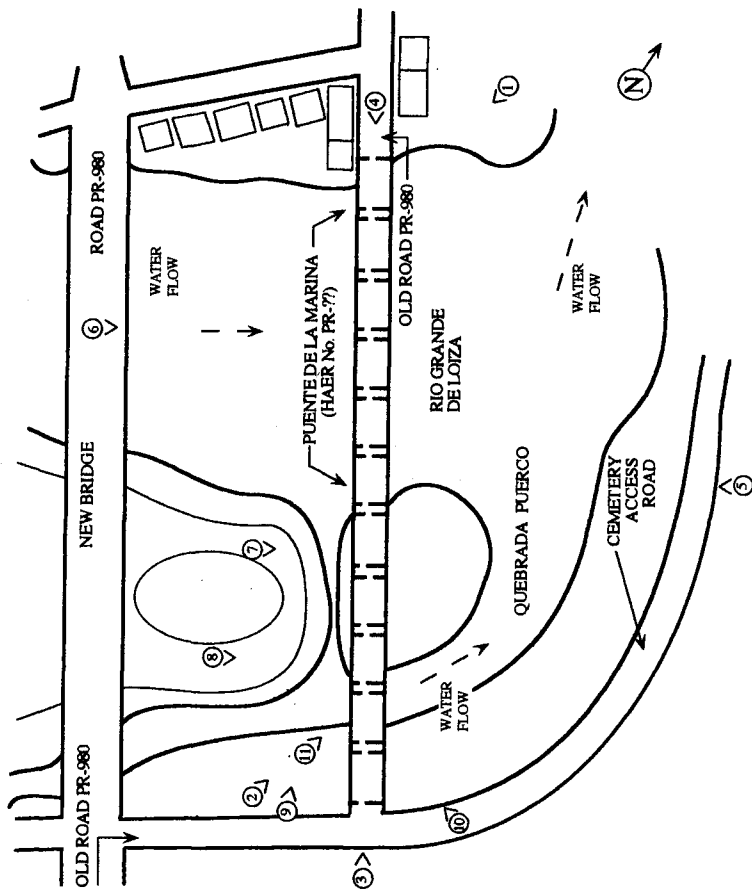
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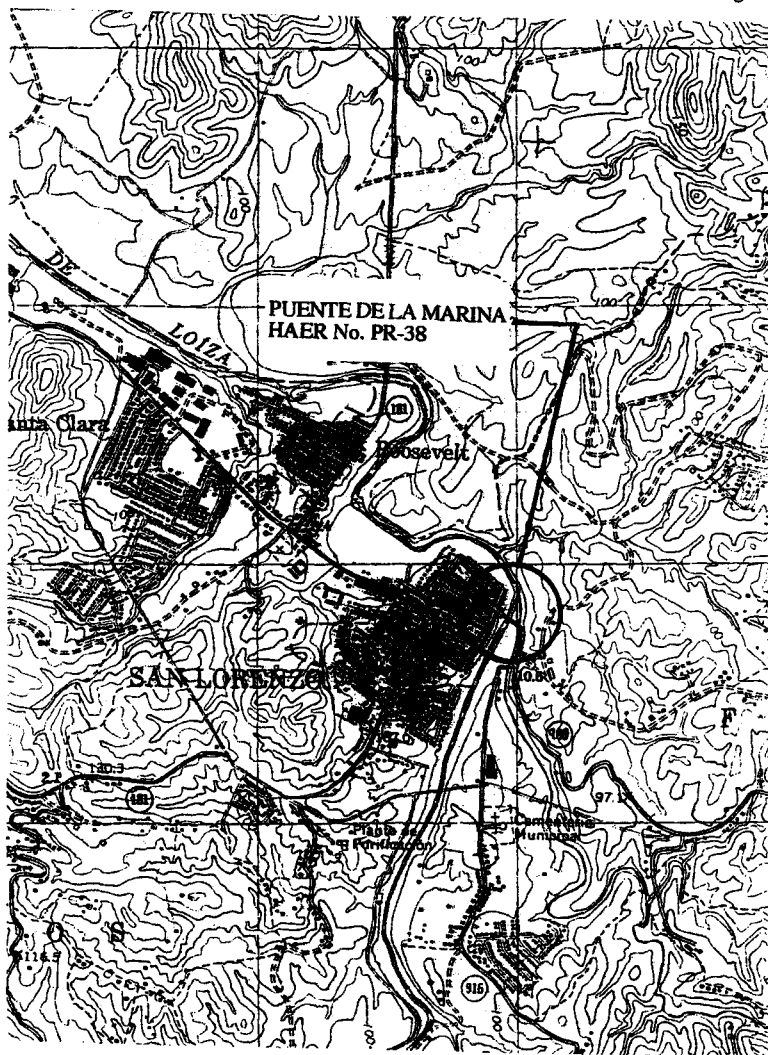
**Published photos of the bridge:**

- El Reportero*. Photo of Puente de la Marina. February 21, 1981, p. S-1. It appears with large pipe just under the road level.
- El Reportero*. Photo of Puente de la Marina. May 19, 1983, p. S-11. Photo in which the Puente de la Marina appears with the steel walkways and the complete removable safety rail.
- El Reportero*. Photo of Puente de la Marina. November 28, 1985, p. S-21. Photo in which the Puente de la Marina appears with the steel walkways and a segment of the removable safety rail.
- El Vocero*. Photo of San Lorenzo. September 5, 1986, p. P-13. Photo in which the Puente de la Marina appears with the steel walkways and no safety rail.
- Marín-Pedraza, Raúl, and Aponte-Roque, Ana M., *La Historia de San Lorenzo*, San Juan: n.p. 1986:
- p.vi. Aerial color photo of San Lorenzo, showing the bridge with the steel walkways.
  - p.199. 2 photos, 1981, from the opposite ends of the bridge. No walkways had been installed yet, but the photo shows two pipes of approximately 16" diameter each, one above the other, on the northeast side.



# PHOTO KEY PLAN

(NOT TO SCALE)



LOCATION PLAN